Farmers' Bulletin No. 571

TOBACCO CULTURE

U. S. DEPARTMENT OF AGRICULTURE

TOBACCO is grown commercially in certain well-defined areas where the soil and climate have been found to produce the desired quality of product. The varieties grown, as well as the cultural and handling procedures, must be adapted to give a cured leaf acceptable to the trade.

Differences in soil and climate have great influence upon the quality of tobacco leaf, and particular types, therefore, are grown chiefly in definite areas. New types are not in demand, and efforts to introduce tobacco culture in new sections are not likely to succeed. There is possibly no other field crop that requires a higher degree of specialization as to culture, harvesting, and curing methods.

When cured the leaf is classified as flue-cured, fire-cured, air-cured, cigar filler, cigar binder, cigar wrapper, and miscellaneous. Each of these classes is divided further into types according to characteristics and appropriate use.

This bulletin indicates the areas in which the different types are produced. It gives the necessary details regarding the varieties of seed to be used and the methods of growing the seedlings, transplanting to the field, fertilizing, cultivating, caring for, and harvesting the crop in each of the more important tobacco-growing regions.

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TOBACCO CULTURE

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LOCALIZATION OF TOBACCO PRODUCTION

INSOFAR AS concerns simply the ability to grow, the tobacco plant readily adapts itself to a wide range of conditions, except that it does not thrive in an excessively wet or waterlogged soil. The plant may be grown successfully in all latitudes from southern Canada to the Tropics and on a great variety of soils. On the other hand, the commercial value of the product is influenced to a greater degree by the particular soil and climatic conditions under which the plant is grown than is almost any other important crop. These facts are so well recognized that the tobacco industry has become highly specialized, and the trade regularly looks to certain well-defined areas of production for its supply of the various kinds of leaf required. In these tobacco-producing districts the necessary facilities for marketing are available, and prevailing prices of the cured leaf are governed

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largely by the relative supply and demand and by the quality of the leaf produced.

Each important district produces a tobacco of certain well-known characteristics that make it desirable for special purposes of manufacture or export. In practically all of these districts the acreage of land actually used for tobacco is much less than that available, so that usually production can readily be increased to meet any increased demand at profitable prices. For these reasons efforts to introduce the commercial growing of tobacco in sections outside of the established producing centers are likely to result in failure; very possibly the leaf produced will not be quite right in type, and it will be difficult to interest leaf dealers and manufacturers in the new product. Furthermore, any development of the industry in a new section on a large scale, which would be essential for economical marketing, would most likely lead to overproduction and, as a consequence, unprofitable prices.

The methods of growing and handling the crop must be varied according to the type of leaf that is to be produced, for the kind of tobacco obtained is influenced very greatly by the methods of growing and handling that are employed. The methods used in the production of the various types, briefly outlined here, though possibly susceptible of improvement in some of the details, are the best according to present knowledge and the experience of investigators and the more successful growers. Only the principal types and producing areas are described.

TYPES OF LEAF TOBACCO

The numerous kinds of leaf tobacco grown in the various centers of production (fig. 1) are classified partly on the basis of their principal uses, partly according to the locality in which they are grown, the special methods of curing employed, or the characteristics of the cured leaf, and in some instances according to the variety of seed used. In the official system of classification of the United States Department of Agriculture each type is designated by number, and the various grades of leaf within the type are indicated by a series of symbols covering the principal characteristics by which the quality of the product is judged. The more important groups of types commonly recognized and their Department of Agriculture type numbers are: Cigar wrapper, types 61 and 62; cigar binder, types 51, 52, 54, 55; cigar filler, types 41, 42, 43, 44; flue-cured, types 11, 12, 13, 14; fire-cured, types 21, 22, 23, 24; light air-cured (burley and Maryland), types 31, 32; dark air-cured, types 35, 36, 37. This classification into types is necessary because each sort designated as a type has its special requirements as to methods and conditions of production, as well as its special commercial uses. The principal uses made of the more important types are indicated in connection with the outlines of cultural methods for each of these types.

THE CULTURE OF CIGAR TOBACCO

While cultural methods in their application to the different cigar-tobacco types and districts may be modified to advantage in some

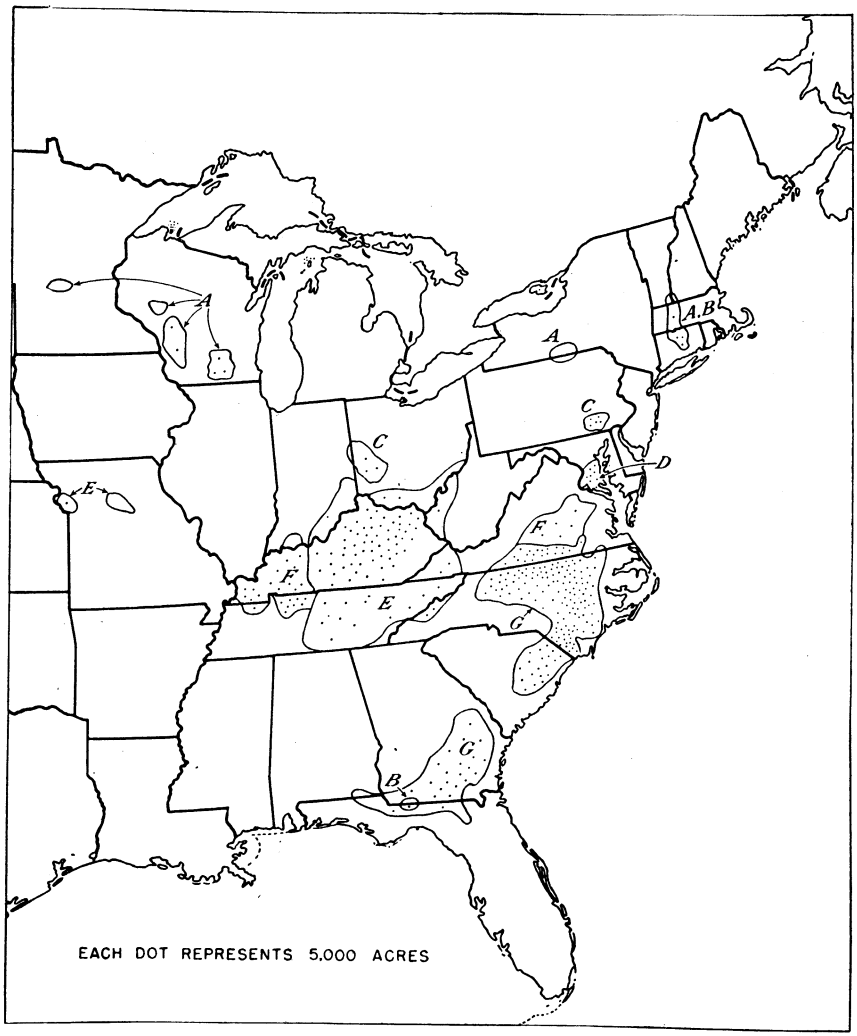

Figure 1.—Distribution of the principal commercial types of tobacco in the United States: *A*, Cigar binder, U. S. types 51, 52, 53, 54, 55; *B*, cigar wrapper, U. S. types 61, 62; *C*, cigar filler, U. S. types 41, 42, 43, 44; *D*, southern Maryland, U. S. type 32; *E*, burley, U. S. type 31; *F*, dark air-cured and fire-cured, U. S. types 35, 36, 37, and 21, 22, 23, 24; *G*, flue-cured, U. S. types 11, 12, 13, 14.

of the details, the essential features are more or less similar, so that it will suffice to outline the most approved methods for the Connecticut Valley, and only the more important differences in cultural methods used in the remaining districts need be mentioned.

CIGAR-TOBACCO VARIETIES

There are three principal varieties or groups of varieties used in growing cigar tobaccos in this country, i. e., the Broadleaf, or Seed-

leaf, group, the Havana Seed group, and the Cuban group. There are numerous local strains of each of these varieties. The typical Broadleaf, or Seedleaf, is the Connecticut Broadleaf, extensively grown in the Connecticut Valley for binders and, to a limited extent, for wrappers. Acclimated strains of this variety have been developed and are grown in all the northern cigar-leaf States for the production of binder and filler leaf, and in each case these strains are given the name of the State in which they are grown. Thus, we have the Pennsylvania Broadleaf, or Seedleaf; the Ohio Broadleaf, or Seedleaf; and the Wisconsin Broadleaf, or Seedleaf, although the latter has been but little used in recent years.

The Connecticut Havana, or Havana Seed, also is extensively grown in the Connecticut Valley for binder- and, to some extent, for wrapper-leaf purposes, and in other northern cigar-tobacco districts for binder leaf and for filler leaf. The name "Havana Seed" frequently is applied to this variety, as grown in any of the northern cigar-tobacco districts, but it is preferable in each case to prefix the name of the State in which it is grown, as is done with the Broadleaf group. There is an important group of so-called Spanish varieties, formerly extensively grown for binder- and filler-leaf purposes, which, however, are merely strains of the Havana seed. The two most important members of this group are Zimmer Spanish, principally grown for filler in the Miami Valley of Ohio, and the Comstock Spanish, chiefly grown for binder leaf in Wisconsin. Zimmer Spanish as grown in Ohio is markedly different in quality from Connecticut Havana as grown in New England, but when the two are grown side by side it is practically impossible to distinguish the one from the other. In recent years numerous numbered selections of Havana Seed have been grown chiefly because of their resistance to black root rot.

Another variety of some local importance in the production of filler leaf in the Miami Valley of Ohio is known as "Little Dutch," of which there are several strains. This variety, which is relatively narrowleaved, is thought to have been introduced from Germany.

The Cuban group is composed of strains or selections obtained from the imported seed and certain new disease-resistant strains developed from crosses of the Cuban sorts. These strains are mainly used in the culture of cigar-wrapper leaf under artificial shade.

CIGAR-WRAPPER AND BINDER TYPES

In the Connecticut Valley and in the area centering around Gadsden County, Fla., and Decatur County, Ga., high-grade wrapper leaf is grown under artificial shade. The open-air or sun-grown product of the Connecticut Valley (Havana Seed and Broadleaf) is chiefly binder leaf. Cigar-binder leaf also is extensively grown in southern and southwestern Wisconsin. The best wrapper and binder soils of the Connecticut Valley are the coarse sandy loam, sandy loam, fine sandy loam, and very fine sandy loam types, with well-drained sandy loam or fine sandy loam subsoils. The wrapper soils of Florida and Georgia also are sandy, sandy loam, and fine sandy loam types with open, well-drained subsoils. The binder-leaf soils of Wisconsin are fine sandy loams, light clay loams, and prairie soils of the dark-loam type.

Connecticut Havana Seed

Preparation and Care of the Seedbed

The young plant is developed from the seed in a coldframe until it has reached a convenient size for transplanting. A convenient width for the seedbed is 6 feet, and it should be of sufficient length to give the required area, 200 square feet being sufficient to produce plants for 1 acre. The best seedbed soil is a mellow sandy loam of high fertility and thoroughly drained.

In the fall a liberal application of manure is plowed under. In addition, in the fall or well in advance of planting in the spring, a suitable fertilizer such as a 5–4–5 mixture may be applied at the rate of about 1 pound per square yard of seedbed and worked into the soil. The soil surface is worked to a state of fine tilth. If the facilities are available, the soil should be sterilized with steam to reduce to the minimum fungus diseases and the growth of weed seeds.[2]

The best time for sowing the beds is from the middle of March to the middle of April. It is seldom safe to set the plants in the field before the middle of May or the first of June, on account of the danger of late frosts and cold nights. From 6 to 8 weeks are required to produce plants of suitable size for transplanting to the field. If cloth instead of glass is used to cover the seedbeds, 8 to 10 weeks are necessary to develop the plants to the proper size for transplanting.

The rate at which the seed is sown is important, for if it is sown too thickly the plants will be delicate and spindling, while very thin seeding will produce short, thick-set plants, poorly suited for transplanting. It is better to sow at the rate of one level tablespoonful or one-half ounce of dry well-cleaned seed to 100 square yards of bed area. It is always well to use only seed tested as to germination. The above amount of seed should be thoroughly mixed in one-half bushel of land plaster, finely sifted wood ashes, or bonemeal, so that it may be distributed evenly. Three sowings should be made in order to insure an even distribution over the bed, the light color of the filler material serving to indicate the evenness of the distribution. The seed must be covered very lightly, and it will be sufficient to go over the bed with a roller or to pack the soil with a plank. After being sown, the beds are covered with glass or with cheesecloth, (fig. 2).

The seedbeds require careful attention, especially those covered with glass. The beds should be maintained in a moist but not wet condition, and should never be allowed to dry. Sufficient ventilation must be given, and the temperature within the beds must not be allowed to become too high, as the plants are very liable to "burn." With glass-covered beds a cheesecloth or light canvas laid over the glass will be found an efficient aid in preventing burning, and during the night the cloth will also check radiation and tend to maintain a warmer temperature within the bed. It is a common practice to make one or more applications of nitrate of soda in water solution or solid form to the young plants to stimulate their growth, and for this purpose 5 pounds of the soda for each 100 square yards of bed may be

[2] See Farmers' Bulletin 1629 for details regarding the steam sterilization of seedbeds.

used. The fertilizer must be washed from the leaves of the seedlings to prevent burning.

When the plants have developed from four to six leaves and are 5 to 6 inches in height, they are ready for transplanting. During the week prior to transplanting, the plants should be "hardened" by removing the cover from the beds during the greater part of the day, increasing the period each day until finally, if the weather is at all favorable, the covers should be left off entirely.

Before the plants are pulled from the beds the soil should be thoroughly wetted, to avoid unnecessary breaking of the roots. The plants should be pulled from the bed separately and put into baskets or small boxes, in which they are carried to the field. They should be kept cool and in a moist condition, especially at the roots. No plant that has wilted should be transplanted.

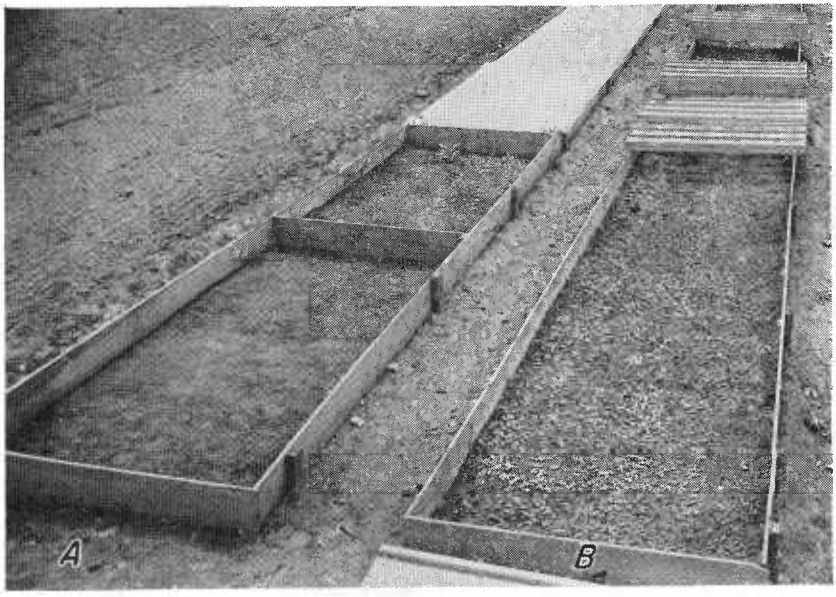

Figure 2.—Tobacco seedbeds in Pennsylvania: *A*, Small plants grown under cloth, as shown in background; *B*, larger plants grown under glass, showing glass partly removed in background.

Preparing and Fertilizing the Land

A rapid and uninterrupted growth is necessary to obtain the finest textured leaf, and clean and thorough cultivation is essential. Care is required in the preparation of the soil, and it should be brought to a fine tilth. Special attention must be given to the matter of fertilizing the crop, and the use of fertilizers containing chlorine is to be avoided, as this element tends to injure the burning qualities of the leaf.

In the preparation of the field 10 to 20 tons of stable manure to the acre may be plowed under, preferably in the fall. Manure is not now used so extensively as formerly, and when employed at all it is

applied as a rule only once in every 2 or 3 years. In the spring the land is again plowed and harrowed. The fertilizers are then broadcast by means of a machine adapted to the purpose.

An application of fertilizer should be made, furnishing the equivalent of 2,000 to 2,500 pounds per acre of a high-grade 8–4–8 mixture. The mixture should also contain 2 to 4 percent of magnesia. As the source of nitrogen, a mixture of cottonseed meal, castor pomace, and fish is used, although as much as one-third of the total nitrogen may be derived from a combination of urea and nitrate of potash or similar sources. Precipitated bone, superphosphate, and bonemeal are suitable sources of phosphoric acid. The potash may be supplied from the carbonate, high-grade sulfate, sulfate of potash-magnesia, vegetable potash, nitrate of potash, or cotton-hull ashes. Tobacco stems, which contain about 5 percent of potash and 1.5 to 2 percent of nitrogen, are regarded as an excellent source of a part or even all of the potash required in the fertilizer. In addition to their content of potash and nitrogen, the stems supply organic matter and also carry other essential elements that may have fertilizing value.

Judicious use of lime, particularly the magnesian forms, tends to improve the burning qualities of tobacco, but since a moderately acid reaction of the soil aids in the control of the black root rot disease the advisability of applying lime will depend primarily on the existing soil reaction. When the pH value of the soil is found to be 5 or lower, use of 500 to 1,000 pounds per acre of limestone containing a high percentage of magnesia is recommended. The magnesia appears to improve the color of the ash of the leaf.

Immediately before transplanting, the field should again be harrowed until all clods are broken. A smoothing harrow and plank should then be drawn over the field, after which the rows are marked off. If a transplanting machine is used, the marking off of the rows is unnecessary, as a marker on the machine can be used to gage the position of each succeeding row.

Transplanting and Cultivating

The plants should be set in rows 3 feet 3 inches to 3 feet 6 inches apart. In the rows the plants may be set from 16 to 20 inches apart, the best distance for average conditions being about 18 inches. The setting of the small plant requires care, in order that the roots may be given an opportunity for rapid development, so that the plants may start to grow promptly. Where a transplanting machine is used the distance of setting, the application of water, and the firm establishment of the plant are automatically regulated; but when the crop is small, say an acre or less, a machine cannot profitably be employed. A type of machine much used in transplanting is shown in figure 3. With the single-row horse-drawn machine transplanter, as shown from southern Maryland, 2 or 3 acres can be set in a day.

In hand-setting, the method (see fig. 12, p. 22) is much the same in all areas as follows: After the rows have been marked on the field, the points at which the plants are to be set may be marked out by running along the row a light, large wheel, with projections set on its rim at

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Figure 3.—Transplanting tobacco with a single-row horse-drawn machine, southern Maryland.

the proper intervals, or by the use of other simple devices for cross marking. A hole 4 to 6 inches in depth is then made with a dibble or some suitable implement to receive the plan. Unless the soil is already thoroughly wet the plants are placed in the holes, some soil may fall or be placed on the roots, but a depression should be provided and filled with water. The water tends to settle the soil firmly around the roots. A hand transplanter, shown on page 17 in figure 9, may be used for this purpose. The surrounding soil may then be drawn about the roots and stalk of the plant and firmly pressed, so that the plant is maintained in an erect position, the bud remaining just above the surface.

If possible, transplanting should be done on a cloudy or rainy day or in the afternoon, so as to avoid excessive wilting. It requires several days for the plants to recover from the shock due to transplanting, but as soon as practicable all plants that have died should be replaced by healthy ones freshly drawn from the seedbed. The field should be gone over at least three times within the first 2 weeks, for it is important to obtain as nearly a perfect stand as possible. Damage from cutworms must be guarded against, and if they are present, constant resetting during the first 3 weeks may be necessary.

After the field has been set about a week, cultivation should begin and should be continued as long as the size of the plants permits. Ordinary surface cultivation to maintain a loose, fine mulch about the plant, with frequent hoeing to keep down weeds, is essential. Cultivation should be shallow, especially in the later stages of growth, to avoid injuring the roots of the plant.

When about one-half of the plants in the field show seed heads and the first blossoms have appeared, topping should be done.

This consists of breaking off the top or crown of the plant at about the third sucker or branch below the seed head so as to allow the plant

to develop the lower leaves more fully. After the tops have been removed, suckers or lateral branches will soon develop in the axis of the leaves, and these should be removed by hand before they become large enough to retard the development of the leaves. In topping and suckering, the field must be gone over two or three times, the aim being to cause all of the plants in the field to mature at about the same time. Hence, those plants developing a seed head later than the average should be topped lower.

Harvesting

Either of two methods of harvesting Havana Seed tobacco may be used. Most commonly the whole plant is cut when the middle leaves are "ripe," i. e., when the leaves have assumed a lighter shade of green and have thickened so that when a section of the leaf is folded it creases or cracks on the line of folding. The crop usually is harvested 2 or 3 weeks after being topped. In harvesting the plants, the stalk is cut near the ground with a light hatchet, knife, saw, or a special form of long-handled shears, and the plant is carefully laid on the ground, where it is allowed to remain until the leaves have wilted sufficiently to avoid much breaking in handling. It is then hung upon a lath 4 feet long by piercing the stalk near its base with a removable metal "spearhead" placed on the end of the lath and sliding the stalk on the lath. As a rule, six plants should be hung on a lath and distributed evenly.

The method of harvesting by cutting and spearing the stalk on the lath is shown in figure 4.

The laths carrying the plants should be placed upon a rack and hauled to the curing barn, where they are hung in tiers with a space of 6 to 9 inches between the laths.

Figure 4.—Harvesting tobacco by cutting the stalk and spearing the plants on the lath.

Another method of harvesting sometimes used for Havana Seed is to pick the leaves from the plant as they ripen.

The degree of ripeness is not so advanced as that described for stalk-cut tobacco. The proper degree of ripeness is very important, for upon this largely depends the development of the desirable qualities of texture, body, color, and elasticity during the process of curing. A safe guide is to take the first picking at the time the seed head forms, and subsequent pickings at intervals of 6 days. Five pickings should be made, the first one comprising the lower four leaves of commercial size and, proceeding upward on the plant, the second and third pickings each including three leaves, and the fourth and fifth pickings three or four leaves each. As the leaves are taken from the plant they should be laid in the row and then carried by an attendant in baskets to the curing barn. Here, by means of a large needle, a string is passed through the stem of the leaf near its base, one end of the string being attached to the end of the 4-foot lath, and when the string is full the free end is attached to the other end of the lath. Each lath should carry 40 to 44 leaves, and the leaves should be put on in pairs, so that they are back to back and face to face. The laths should be spaced 5 inches apart in the curing barn. (See fig. 6.)

Connecticut Broadleaf

The methods of preparing the seedbed and the land are the same for Connecticut Broadleaf as for Havana Seed. In setting Broadleaf in the field, the distance between plants should be greater than in the case of the Havana Seed, on account of the larger size of the leaf of the former. The best distance for setting the plants in the row is 20 to 25 inches, and the rows should be from 3 feet 4 inches to 3 feet 9 inches apart, but otherwise the cultural methods to be followed are about the same as for Havana Seed. The same fertilizers are used as for Havana Seed. The Broadleaf should be harvested by cutting the stalk in the manner described for Havana Seed.

Comstock Spanish and Wisconsin Havana Seed

The Comstock Spanish variety, along with the ordinary Havana Seed, is specially adapted to the production of binder leaf in Wisconsin. The seedbeds should generally be sown during the latter half of April. Barnyard manure, at the rate of 20 tons per acre, is used with good success in fertilizing the tobacco soils, but thus far commercial fertilizers have been used more sparingly than in the Connecticut Valley. Transplanting from the seedbed to the field under normal conditions should be done during June, more commonly during the latter half of the month. The rows should be 34 to 38 inches apart, and the plants should be set 18 to 22 inches apart in the row. Harvesting, which is done by cutting the stalk in the manner described for Havana Seed, should begin about 3 weeks after topping.

Shade-Grown Wrapper Leaf

In the production of high-grade cigar-wrapper leaf under artificial shade (fig. 5), selected strains of Cuban are used in the Connecticut

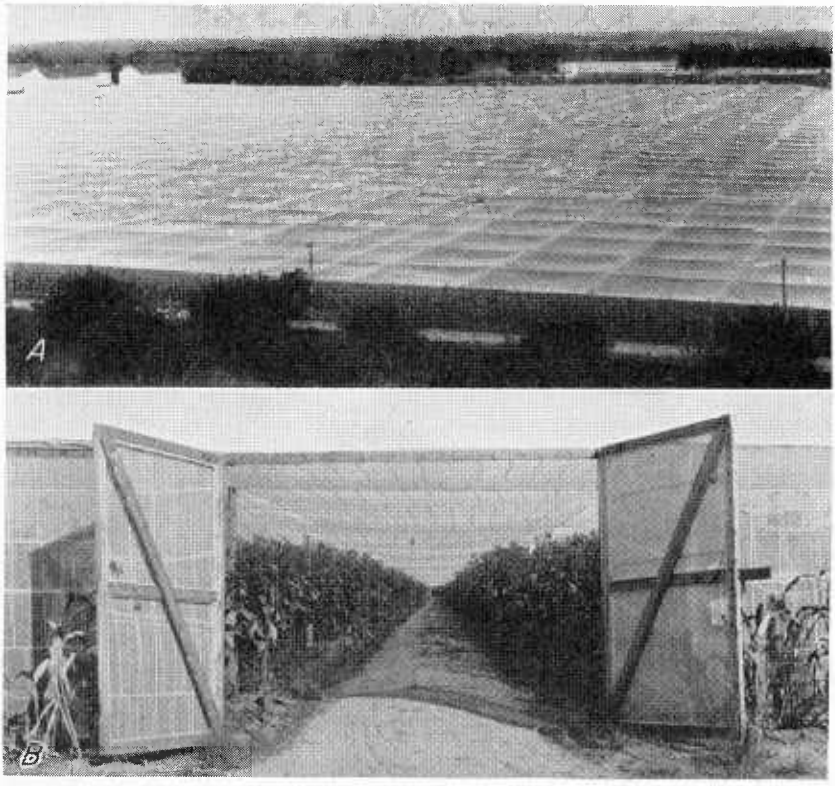

Figure 5.—A, A large field in Connecticut of shade-grown cigar wrapper covered with cloth; *B,* interior view of shade, showing mature crop from which the lower leaves have been harvested.

Valley. In the Florida-Georgia wrapper district, the Big Cuban and Round Tip varieties formerly used were first largely replaced by No. 301, which was developed from a cross of Big Cuban and the ordinary Cuban and is resistant to the black shank disease. Another improved variety that is resistant to black shank, known as RG, is now grown extensively.

The artificial shade consists essentially of a wire frame about 8 feet high supported by stout posts, over the top and sides of which the cloth or slat shading material is spread. For cloth shade the posts are usually spaced 33 feet apart, so as to form uniform bents, or squares, across the field, except that in the outside rows the spacing is often closer. For slat shade, which was commonly used until recent times, the spacing is 18 by 22½ feet or 13½ by 27 feet, and in the outside rows on two sides the posts are only 2 or 4 feet apart.

In the Connecticut Valley cloth is the only shading material in use, while in the southern district either cloth or slats similar to plastering laths, or a combination of the two, is employed. In both districts, however, cloth is used for the side walls. The cloth is a coarse loosely woven material containing either 8 threads to the inch each way or

10 threads one way and 8 the other, with reinforcing bars at frequent intervals. It comes in strips 400 inches wide and 125 feet long. The cloth is stretched over the framework and sewed to the supporting wires. It is placed in position in the spring prior to transplanting and is removed after the crop has been harvested. The slats employed for shading are 48 or 52 inches long and 1½ inches wide and are spaced 3 to 6 inches apart, depending on whether they are used alone or in combination with cloth. The slats are held in place on the wires supporting them at the ends and in the center by double-wrapping with a finer wire. In the combination shade the cloth is placed beneath the slats and supported by wires. In recent years there has been a decided shift to cloth alone in the southern district.

In the Connecticut Valley the system of fertilizing, including the use of manure, is similar to that outlined for Connecticut Havana Seed. In the Florida-Georgia district 10 to 15 tons of manure per acre are used whenever available. In addition, commercial fertilizers are used in quantities to furnish a total of about 225 pounds of nitrogen, 215 pounds of phosphoric acid, and 240 pounds of potash per acre, including the quantities of these nutrients supplied by the manure. The fertilizer materials most used are about the same as those suggested for the Connecticut Havana Seed. In transplanting, the rows are spaced 40 inches apart in the Connecticut Valley and 48 to 54 inches apart in the southern area, and the plants are set 10 to 15 inches apart in the row. The plants are topped very high, the flower head being removed before the blossoms open. The crop is harvested by the priming method (fig. 6), as described for Havana Seed, the first picking of about three leaves being made at time of topping. Sub-

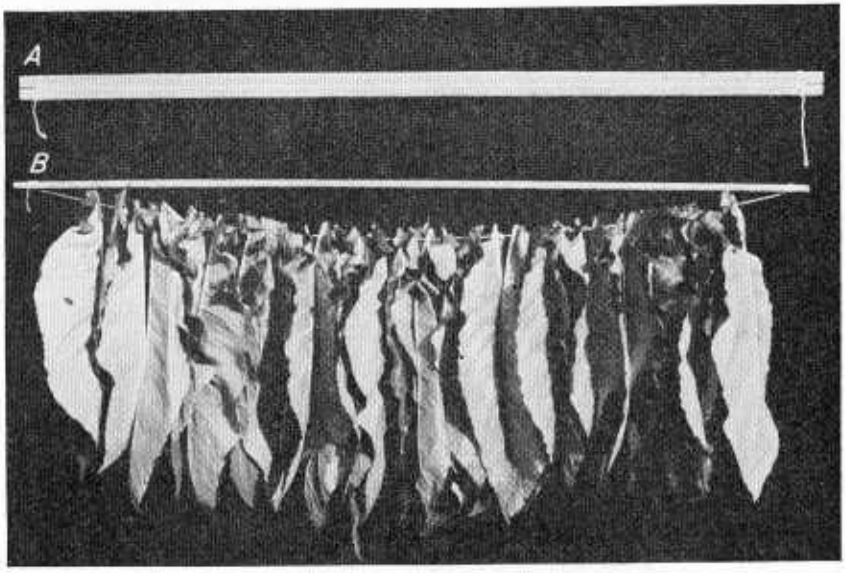

Figure 6.—*A*, Lath, showing method of attaching string; *B*, lath of shade-grown wrapper, showing method of sewing the leaves with a needle, face to face and back to back, in pairs.

sequent pickings of three or four leaves each are made at increasing intervals up to 7 to 10 days or longer between the fourth and the fifth pickings.

CIGAR-FILLER LEAF

Domestic cigar-filler leaf is produced mainly in the Lancaster (Pa.) and the Miami Valley (Ohio) districts. The best filler-leaf soils, mostly loams, are decidedly stronger than those adapted to the binder and wrapper leaf, containing more silt and clay and retaining larger percentages of water. In the main, these soils are well adapted to general farming, and the tobacco is, or should be, grown in rotation with other crops. Cultural methods differ principally from those followed in the binder and wrapper districts, in that the plants are spaced farther apart in the field and are topped lower so as to obtain a heavier leaf, and the tobacco is allowed to become riper before it is harvested. In general, less intensive methods are followed, since filler leaf commands only moderate prices.

Pennsylvania Broadleaf

Typical soils on which cigar filler is grown in the Lancaster district are the Duffield, Hagerstown, Dunmore, and Conestoga silt loams, all of limestone origin. For Pennsylvania Broadleaf the method of preparation and the care of the seedbed are essentially the same as in the binder and wrapper districts. The seed usually should be sown during the first half of April, and transplanting, which is generally done with a tractor-drawn transplanter (fig. 7), should take place through the month of June. The soil needs to be put in good condi-

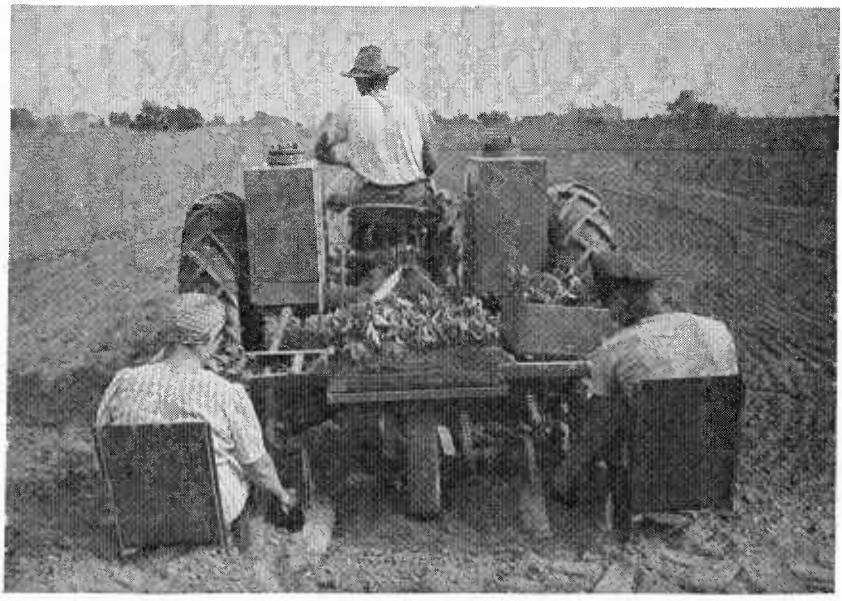

Figure 7.—Transplanting tobacco in Pennsylvania, with a two-row tractor-drawn machine.

tion by plowing and harrowing. Stable manure should be used liberally, usually at the rate of approximately 10 tons or more per acre. As a supplement to the manure, a commercial fertilizer consisting of about 1,000 to 1,500 pounds of 4–8–12 per acre or other similar mixture, usually will improve both the yield and the quality of the crop. The rows should be 3 to 3½ feet apart, and the plants should be set 24 to 30 inches apart in the row. Cultivation is now largely carried out by tractor equipment. The better practice is to top the plants before the flower head begins to bloom, and a smaller number of leaves should be left than in the case of binder types. The suckers must be promptly removed as they develop. The tobacco must be allowed to become fully ripe, as judged by the signs indicated for the binder type, and should be harvested by cutting the stalk at its base and spearing it on laths, as described for Connecticut Havana Seed.

Zimmer Spanish

The Zimmer Spanish variety is grown principally in the Miami Valley of Ohio. Among the principal soil types are the Bellefontaine, Miami, and Crosby silt loams and Brookston silty clay loam. The so-called Zimmer Spanish seems to be practically identical with Havana Seed, as has already been stated. The seedbeds are best sown during the latter part of March and through April. Transplanting should be done during the first 3 weeks of June. Commercial fertilizers should be used freely, and good results are obtained in applying as much as 1,000 pounds per acre of a mixture analyzing about 4 percent nitrogen, 9 percent phosphoric acid, and 8 percent potash—that is, one supplying about 40 pounds of nitrogen, 90 pounds of phosphoric acid, and 80 pounds of potash. Barnyard manure also gives good results. The rows should be placed 34 to 38 inches apart and the plants set 22 to 26 inches apart in the row. The plants should be topped before they bloom and should be kept free from suckers. The time and method of havesting are about the same as for Pennsylvania Broadleaf.

THE CULTURE OF FLUE-CURED, FIRE-CURED, AND AIR-CURED TYPES

VARIETIES

In the culture of the flue-cured, fire-cured, and dark air-cured tobacco types an exceedingly large number of so-called varieties are used, but, with the possible exception of the sort known as One Sucker, all of these may be regarded as only strains of a fundamental variety, the Orinoco. Even some of the older, more widely known sorts of Orinoco, such as Pryor, exist in several different forms. In the culture of flue-cured types the White Stem Orinoco, Cash, Jamaica, Virginia Bright, Bonanza, and Yellow Pryor are among the more popular strains of Orinoco now in use. Where diseases are a problem, resistant strains have come into use, including those of the 400 and related varieties; Oxford and Vesta strains, resistant to black shank; and Oxford 26, resistant to Granville or bacterial wilt. For pro-

duction of fire-cured and dark air-cured leaf in Virginia the Lizard Tail Orinoco, Big Orinoco, and Narrowleaf Orinoco are extensively employed. In the culture of the dark air-cured type known as One Sucker a variety bearing the same name is used, and for the production of other dark air-cured and fire-cured types in Kentucky and Tennessee several forms of Pryor, which is similar to, if not identical with, the Orinoco, are widely used. Among these are Yellow Pryor, Blue Pryor, Madole, and Yellow Mammoth.

White Burley is a distinctive variety, producing a type of cured leaf known as burley, nearly all of which is used in domestic manufacture. Apart from the peculiar cream color of the leaf midrib and the stalk, and the yellowish-green color of the older leaves, White Burley rather closely resembles the Maryland Broadleaf. The numerous strains of White Burley may be roughly grouped into drooping or broadleaf sorts and the more erect sorts commonly known as stand-up. In recent years the more erect sorts have been chiefly grown for the reason that they produce a somewhat greater proportion of the cigarette grades of leaf than the drooping sorts. Varieties of White Burley resistant to black root rot, such as Kentucky 16, are grown extensively.

The Maryland is another fairly distinctive variety, in many respects resembling the cigar seed-leaf and White Burley varieties. The type of leaf produced is known as Maryland tobacco. Two subvarieties of the Maryland are known as Broadleaf and Medium Broadleaf, respectively.

Flue-Cured Tobacco

The flue-cured types, frequently spoken of as bright tobacco, are extensively grown in southern Virginia, northern and eastern North Carolina, eastern South Carolina, southeastern Georgia, and northern Florida. Flue-cured leaf is used in the manufacture of cigarettes and smoking and chewing tobaccos and for export. The bright yellow color of the leaf is due mainly to the character of the soil upon which it is grown and to the method of curing. The typical soils are light sands, coarse sandy loams, sandy loams, and fine sandy loams with yellow or red sandy and sandy loam subsoils containing relatively small proportions of clay, except in the Piedmont, when the subsoil is distinctly clayey.

The Seedbed

A well-drained friable soil having a southern or eastern exposure is to be preferred for the seedbed, and when practicable a suitable spot in the woods is chosen. After the forest growth has been removed and at a time when not too wet, the soil is thoroughly spaded or plowed to a depth of 4 or 5 inches. It may then be burned to destroy weed seeds, diseases, and insects. A good method is to lay small poles or skids over the area to be burned, at intervals of 4 feet, and to pile brush and wood on one end of the skids. After the brush is set on fire the burning material is pulled forward on the skids as rapidly as the soil becomes sufficiently heated and sterilized to a depth of 2 or 3 inches.

Where the necessary equipment is available, the method of steam sterilization referred to on page 5 gives excellent results. Chemical

treatments such as 1 pound of urea and ½ pound of cyanamide per square yard of seedbed area, applied 60 to 90 days prior to seeding, are being used widely at the present time on light soils on temporary sites with good results as to weed and disease control. Before seeding, a commercial fertilizer analyzing around 9 percent phosphoric acid and 4 percent each of nitrogen and potash should be raked in at the rate of 1 or 2 pounds per square yard.

In sowing, the seed should be mixed with a large volume of fertilizer, corn meal, or sifted ashes (about 1 bushel for each ounce of seed), in order to obtain an even distribution of the seed. A heaping teaspoonful of seed is sufficient to sow 25 square yards of seedbed and should furnish enough plants to set an acre in the field. In an effort to insure an adequate supply of seedlings suitable for transplanting it has become the common practice to provide 50 to 100 square yards of seedbed area for each acre to be grown. The seedbeds may be sown in January, February, or March. The seed must be covered only very lightly, and it is better simply to press the soil down firmly by trampling or with a board or roller. The bed (fig. 8), which may be of any convenient size and shape, should be surrounded with boards set on edge to a height of 6 to 10 inches to form a coldframe, over which are stretched wires to support the cheesecloth that is to be placed over the frame before the plants come up. The precautions regarding watering and hardening the plants prior to transplanting, as described for the cigar types, are to be carefully followed.

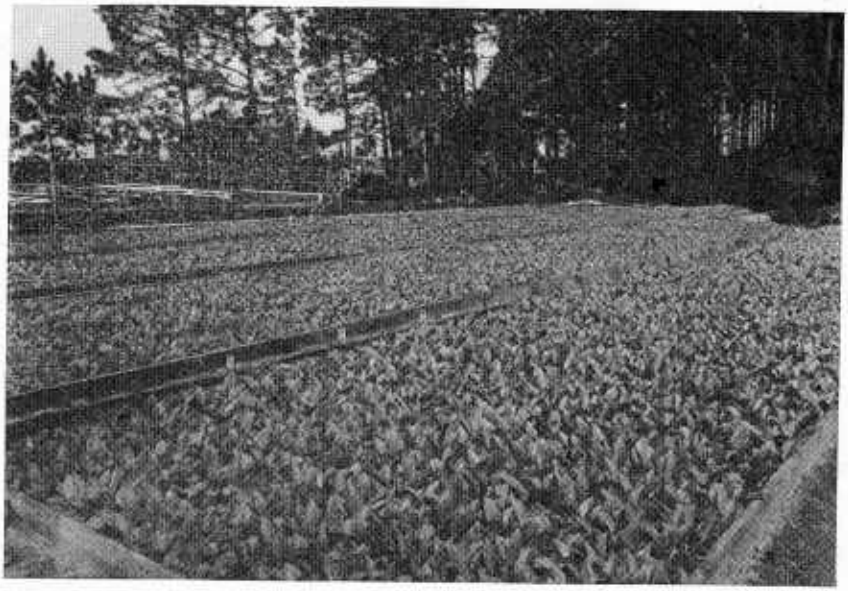

Figure 8.—Tobacco seedbed in southern Georgia, showing excellent stand of plants about ready for transplanting.

Transplanting, Fertilizing, and Cultivating

Prior to transplanting, the land should be thoroughly fitted by plowing and harrowing, finally throwing up low ridges for the rows. The

rows should be laid off 4 feet apart and the plants set 20 to 28 inches apart in the row. Transplanting by various methods, as for cigar tobacco (fig. 9 shows hand transplanter), should begin about the first of April in South Carolina and Georgia and extend into May or even June in the western parts of the North Carolina district. The bright-yellow color of this type is one of its most valued characteristics, and for this reason large quantities of nitrogenous fertilizers must be avoided. The soils producing the best quality of leaf are naturally infertile, and commercial fertilizers are universally used, although the proportion of nitrogen in the fertilizers must be kept comparatively low.

Figure 9.—Planting tobacco in North Carolina with a hand planter that adds water as plant is set. Boy is carrying water to replenish supply in planter.

For the heavier, more productive soils, a fertilizer supplying the equivalent of 800 to 1,000 pounds of a mixture containing 3 percent nitrogen, 10 percent available phosphoric acid, and 6 to 10 percent potash is recommended. For the lighter, less productive soils, 800 to 1,200 pounds per acre of a mixture analyzing 3 percent nitrogen, 9 percent available phosphoric acid, and 6 to 10 percent potash is suggested. In addition, the fertilizer for flue-cured tobacco should contain 2 percent of chlorine, 2 percent of available magnesia, and not less than 6 percent of available calcium, while some sulfur is essential, although the more easily soluble forms should be avoided. It is suggested that one-fifth of the nitrogen of the fertilizer be derived from standard organic sources, such as fish scrap, cottonseed meal, and high-grade tankage; one-fifth from materials supplying nitrogen in the form of nitrate; and the rest from urea or standard inorganic sources. Phosphates supplying readily available phosphorus are suitable sources of phosphoric acid, and the potash may be derived from any

source of available potash. Liming of tobacco soils is seldom necessary or desirable except that occasional very light applications of magnesian limestone may be employed to supply magnesia and calcium. Light applications of well-rotted manure in the fall or early spring are beneficial as a supplement to commercial fertilizer.

Cultivation should begin as soon as the plants start to grow and should continue as long as the size of the plants will permit. The first cultivation is fairly deep, after which frequent shallow cultivations are most desirable. In the final cultivation the plants should be left on a high, broad bed.

When the flower heads begin to show, the plants are topped. In the Piedmont section 10 to 14 or more leaves are left on the plant, depending on the richness of the soil and the vigor of the plant. In the Coastal Plain section the plants are topped somewhat higher, 12 to 16 or 18 leaves to the plant being left. The suckers must be removed at intervals of a week or 10 days and it may be necessary to go over the field five or six times.

Harvesting

Flue-cured tobaccos should be thoroughly ripe when harvested. The leaf surface should show numerous patches of a light-yellow color, and even the green portions should be of a light tint; otherwise it will be difficult or impossible to cure the leaf properly. In the flue-cured districts the method of harvesting is to pick off the leaves as they ripen, often referred to as "priming," beginning at the bottom of the plant and taking two or three leaves at each picking.

Figure 10.—Stringing or tying flue-cured tobacco on sticks. Three to five leaves in bunches are looped alternately on each side of the stick, and no needle is used. The stringing is usually done near the curing barn.

The leaves should be taken to the barn and attached in small bunches to the sticks by means of strings (fig. 10). The string is attached to one end of the stick and near this end it is passed once around the stems of three to five leaves, thus forming a small bunch that will hang to one side of the stick. The string is then drawn diagonally to the opposite side of the stick and similarly looped around a second bunch of leaves and the process repeated until the stick is full, when the free end of the string is attached to the other end of the stick. The sticks are 4½ feet long and should contain 25 to 30 bundles of leaves. The field must be gone over from two to four times, in order to get all the plants at the right stage of ripeness.

Fire-Cured Tobacco

The fire-cured types of tobacco are grown almost exclusively in western Kentucky and Tennessee and in central Virginia. Their principal characteristics are their dark color, heavy body, and a distinctive flavor imparted to them by the smoke of the open fires used in curing. The greater portion of these types is exported, but they are also used for the production of snuff and as a plug wrapper. The soils producing the fire-cured leaf are heavy loams, containing a high percentage of clay or silt, and hence would not be adapted to the culture of most other types of tobacco.

The methods of preparing and caring for the seedbeds are essentially the same as those for flue-cured tobacco.

Prior to transplanting, the land should be thoroughly fitted by plowing and harrowing, after which the rows are laid off, the preferred distance between rows being 3½ feet. In Kentucky and Tennessee the plants are usually set in checks; that is, they are set 3½ feet apart each way, whereas in Virginia they are generally spaced 2½ to 3 feet apart in the row. The accurate spacing of the plants may be readily attained by using a simple marking device, which is drawn across the field so as to indicate the points at which the plants are to be set. Throwing up slight ridges for the rows will remove the danger of the young plants being drowned in case of heavy rains. Transplanting is done mostly by hand and in much the same way as has been described for the cigar tobaccos. Fertilizers should be applied in the process of preparing the land for transplanting. Very little barnyard manure is available in the fire-cured districts, and commercial fertilizers are generally used rather sparingly, the usual application being 200 to 600 pounds per acre of a mixture containing about 3 percent of nitrogen, 8 percent of phosphoric acid, and 5 percent of potash. Much larger quantities of fertilizer will give better results in most cases. A clover sod plowed under in the fall gives good results with this type of tobacco.

Cultivation should begin as soon as the plants start to grow and should continue as long as the size of the plants will permit. The first cultivation is deep, after which frequent shallow cultivations are most desirable. Where the plants are set in checks they may be cultivated both ways, so as to reduce the amount of hand-hoeing required to keep down weeds.

When 10 to 15 leaves have appeared on the plant the top should be broken out, so as to force all the growth into the leaves left on the

plant and cause them to grow larger, thicker, and darker. A favorite practice is to pick off and discard 3 or 4 of the bottom leaves and then top the plants so as to leave 8 to 12 leaves on each plant. High topping tends to delay maturity and to produce a thinner leaf. The aim in topping is to leave only as many leaves on the plant as it can bring to the fullest development and as far as possible to insure that all plants will mature at about the same time. The suckers that develop in the axils of the leaves must be removed as often as they appear.

The plants generally are ready for harvest in from 30 to 40 days after topping. At this stage the leaves will have taken on a lighter color and become thick and heavy, and small yellow flecks will have appeared, especially near the edges of the leaf. It is not desirable to harvest the tobacco for 2 or 3 days after a heavy rain, as the gum that accumulates on the leaf in dry weather and improves its quality is washed off by the rain. In harvesting, the stalk should first be split with a knife from the top down to within a few inches of the bottom, in such a way as not to cut or injure the leaves. The stalk is then cut off near the ground and laid on the ground to wilt sufficiently to permit handling without breaking the leaves. The plants should then be placed astride sticks and hauled to the curing barn. In Virginia the plants are usually placed on the sticks before being laid on the ground to wilt. The sticks are 4 feet 4 inches long, and five to eight plants, depending on their size, should be placed on each stick. The sticks carrying the plants should be arranged on the tier poles of the curing barn at intervals of 6 to 8 inches.

White Burley Tobacco

White Burley tobacco reaches its highest state of development on the limestone soils in the famous bluegrass section of Kentucky, in the eastern Tennessee district, and in southern Ohio. This type is light in color and body and possesses an exceptionally large absorptive capacity for the liquid flavoring materials used in the manufacture of plug tobacco. Burley is now a very important cigarette type.

The methods of preparing, sowing, and caring for the seedbeds are about the same as those described for flue-cured tobacco. Burley tobacco gives the best results when grown on virgin soil or on a bluegrass sod that has been standing for at least 6 or 8 years. Under these conditions two or three excellent crops of tobacco can be obtained, after which, unless root-rot-resistant strains are planted, the results are unsatisfactory until the land has again stood in bluegrass for several years. In preparing the land, a bluegrass sod should be turned under in the fall and thoroughly cultivated with a disk harrow in the spring. On a heavy bluegrass sod, manure or fertilizers may not be required for the tobacco. Under other conditions 500 to 1,500 pounds per acre of fertilizer analyzing around 9 percent phosphoric acid, 3 percent nitrogen, and 6 percent potash usually give profitable returns. If manure is used liberally the nitrogen content of the fertilizer may be reduced.

Burley tobacco plants should be set 14 to 18 inches apart in the row, with the rows 3½ feet apart. Transplanting by machine has proved very satisfactory. Cultivation should be shallow, frequent, and thor-

ough. The tobacco must be topped comparatively high, from 14 to 18 leaves being left on the plant. Careful attention must be given to the removal of the suckers. The crop should be harvested in the same manner as the fire-cured tobacco, except that, when cut, it is preferable that the plants be immediately speared onto the stick, one end of which is forced into the ground at an angle in such a position that the stick bearing the plants rests on the stubble of a severed plant (fig. 11).

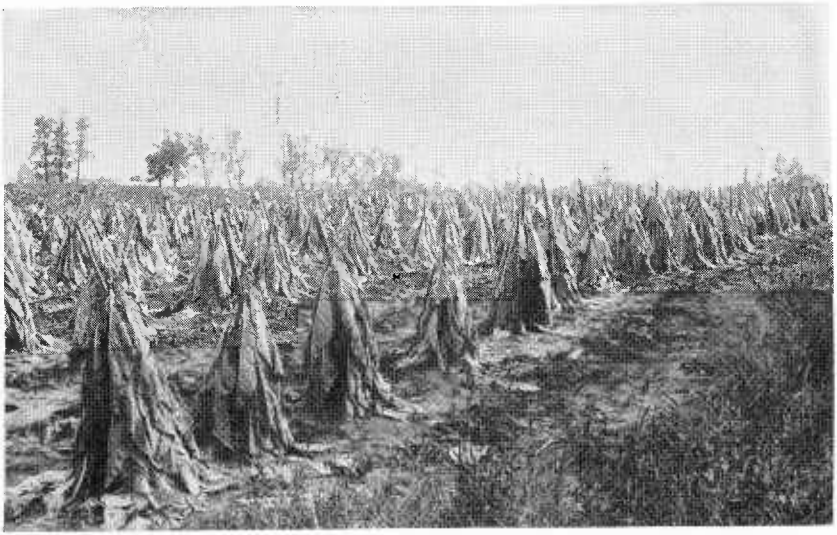

Figure 11.—After cutting, burley tobacco is commonly speared onto a stick, one end of which has been forced into the ground. Wilting is hastened by this exposure.

The tobacco is to be left in this position till wilted and then carried to the curing barn. However, the removable spearhead is now much used in stringing the plants on the stick, as is done with the cigar tobaccos. There is some interest at the present time in regard to harvesting the leaves as they ripen, as described for Havana Seed, page 10. The sticks bearing the plants should be placed 8 to 10 inches apart on the tier poles.

Maryland Tobacco

The Maryland type of leaf is produced extensively in the counties of Prince Georges, Anne Arundel, Charles, Calvert, and St. Marys, which constitute the area commonly known as southern Maryland. The desirable grades of the Maryland leaf are thin, of good length, light in body and color, of a dry or chaffy character, and have good burning qualities. The principal use of Maryland tobacco is for manufacture of blended cigarettes, although a considerable proportion of the crop is exported. The sandy loam, fine sandy loam, and very fine sandy loam types of soil are best for the crop. Fairly heavy loams also are used to some extent but do not produce the best quality of leaf. Methods of preparation, fertilization, planting,

(figs. 3 and 12) and caring for seedbeds are essentially the same as those for cigar tobaccos, except that a location in the woods is preferred, and a loosely woven cheesecloth rather than glass is employed as a cover.

Preparation of the soil is similar to that for other types of tobacco. The tobacco crop does especially well on rested land that has been in weeds for a year or more. For average conditions, 600 to 1,000 pounds per acre of a fertilizer analyzing 4 percent nitrogen, 8 percent phosphoric acid, and 12 percent potash is recommended, applied in the row. After legumes or on strong, rested land the nitrogen content of the mixture may be reduced to 2 percent. It is advisable to ridge slightly the rows for transplanting. Transplanting is chiefly done by hand, as described for cigar tobaccos, or with hand transplanters (see fig. 9). The plants are usually set in squares, being

Figure 12.—Dropping tobacco plants and hand-setting in southern Maryland, following a rain. Under these conditions no additional water is used. Note slight ridges and cross marking.

spaced 32 to 36 inches apart each way, and cultivation may be in both directions. The plants are topped to 16 to 20 or more leaves, depending on their vigor and the seasonal conditions. The present tendency is to defer topping till after flowering begins or even till just before harvest, and in the latter case to top low, the purpose being to reduce the costs of suckering and to increase the percentage yield of thin, bright leaf. The tobacco is harvested by cutting the stalk and spearing on sticks, as described for the cigar-leaf types. A field of Maryland tobacco nearly ready for harvesting is shown in figure 13.

Dark Air-Cured Tobacco

In the part of Kentucky and Tennessee lying between the burley district and the dark fire-cured sections, types of tobacco are produced in large quantities suitable for domestic manufacture into

Figure 13.—A, Mature plant of Maryland tobacco, topped and suckered prior to harvesting. *B,* Field topped and suckered preparatory to harvesting. Two selected plants have been allowed to mature seed, which is a common practice in obtaining seed for another crop.

chewing and smoking tobacco and for export. These types are mostly air-cured, like burley, but in other respects the methods of production are quite similar to those followed for the dark fire-cured tobacco. In the southern parts of this territory, centering around Warren County, Ky., the so-called One Sucker variety is extensively grown and the type of leaf produced is known by the same name.

In the few counties of Virginia immediately north of Richmond a type of leaf long known as Virginia Sun Cured is produced. Formerly the tobacco was exposed to the sun in the process of curing (hence the name), but at the present time air-curing as practiced in the burley district is the more common method. This type is spe-

cially adapted to the manufacture of chewing tobacco. Aside from the curing and somewhat higher topping, substantially the same methods of production should be followed as have been outlined for the fire-cured export tobacco.

TOBACCO DISEASES AND THEIR CONTROL

The tobacco plant is attacked by a number of diseases, but only some of the more important ones can be considered in this bulletin.

SEEDBED SANITATION

Prevention rather than cure is the keynote in the control of most tobacco diseases. Several of the more important diseases such as mosaic and bacterial leaf spots commonly originate in the seedbed, and, consequently, special effort should be made to prevent infection in the young seedlings. The seedbed preferably should not be located near curing barns, tobacco fields, or weedy areas. It is very important that no old tobacco material of any sort be allowed to reach the bed. Unless woods land is used for the seedbed the soil should be sterilized, preferably by thorough steaming as described in Farmers' Bulletin 1629, Steam Sterilization of Soil for Tobacco and Other Crops. Unless new, the frames and covers of the seedbed should be disinfected by being sprayed with a solution of formaldehyde, corrosive sublimate, or other disinfectant, by being steamed, or by being boiled in water. It is a mistake not to examine carefully the tops and roots of the seedlings for evidence of disease at the time of transplanting. As a rule it is best not to use plants from beds in which any of the dangerous parasitic diseases are present.

ROOT ROT

One of the most important and widespread diseases affecting the plant is known as black root rot. Usually this disease can be readily recognized by carefully examining the roots, which are seen to be more or less decayed, the smaller roots especially showing blackened portions. The plants do not start to grow properly and may wilt in sunshine even though the soil is moist. The symptoms above ground often merely suggest an infertile soil, need of fertilizer, too much water, and the like. This disease is due to a fungus (*Thielaviopsis basicola*), which persists in the soil from year to year and in addition to tobacco attacks cowpeas, the clovers, and other legumes. Cool weather, such as occurs in a late wet spring, greatly favors the disease, while very hot dry weather may soon check it, causing the plants to develop new roots near the surface of the ground, where the soil is warmest, and to begin growing.

The disease may be controlled in the seedbed by sterilizing the soil through the use of steam or of formaldehyde. Diseased seedlings should never be set in the field, for this may be a means of spreading the trouble. The ordinary varieties of White Burley tobacco are very susceptible to the disease, but highly resistant strains of burley as well as of some of the northern cigar-tobacco varieties have been developed

recently and may be successfully grown on diseased land. Resting the land for several years or the rotation of crops (avoiding legumes) will tend to reduce the injury from root rot. The relation of the soil reaction to the disease has been referred to on page 7.

On many soils tobacco may be grown very successfully in rotation with various other crops, but on other types of soil certain crops when preceding tobacco in the rotation may have a seriously depressing effect on the growth of the tobacco. In this case the roots of the tobacco are not fully developed and have a brown or yellow color, hence, the trouble has come to be known as brown root rot. Among the crops likely to produce this effect on tobacco are timothy, rye, corn, and the common legumes. The exact nature of this unfavorable crop effect is not fully understood. It is not corrected by heavy fertilizing or by liming. Continuous culture of tobacco or resting the land tends to obviate or correct the trouble, and continuous culture combined with the use of strains of tobacco resistant to the black root rot may make possible the control of both forms of root rot. A free living form of nematode, known as meadow nematode, has now been shown to be a possible explanation for some of the effects formerly called brown root rot.

THE TOBACCO WILT (GRANVILLE WILT)

Tobacco wilt, or Granville wilt of tobacco, is a serious bacterial disease that attacks a number of plants besides tobacco. The germ enters the plant through the roots and multiplies so rapidly that the water-conducting vessels become clogged, causing the leaves to wither and perish. The woody part of the stalk shows a yellowish to black streak when the bark is stripped off. The disease originally occurred in Granville County and then spread to the adjoining counties of North Carolina, but it is gradually spreading in other parts of the flue-cured area. Fertilizers have nothing to do with the occurrence of the wilt. The systematic and persistent rotation of crops is a helpful method of combating the disease. Crops that are attacked should not be planted, and tobacco must not be grown on the land oftener than once in 4 or 5 years. Corn, cotton, sweetpotatoes, redtop or herd's-grass, and other grasses, cowpeas, wheat, oats, rye, and the clovers are immune and may be used in the rotation. Resting the land will not give good results, because ragweed, which is so common on tobacco fields and certain other weeds, are attacked by the wilt organism. The use of resistant tobacco varieties such as Oxford 26 offers the best control known for this disease.

BLACK SHANK

Black shank is one of the most destructive tobacco diseases known. It is caused by a soil fungus and may attack the plant at any stage of growth. In older plants the disease may first be evident in the top or main lateral roots, followed by rapid discoloration of the basal part of the stalk, followed by wilting and death of the plant. The pith of the diseased areas of the stalk usually separates into disks.

The black shank disease of tobacco caused serious losses in Florida until the resistant strains (p. 11) were developed. This disease has

now spread into considerable areas in North Carolina and Virginia, but resistant varieties (p. 14) suitable for flue-curing are now available and furnish the best control known for this disease. The disease has been found in Kentucky, Tennessee, and South Carolina.

ROOT KNOT

Tobacco may be severely injured on light sandy soils in the South by a minute eelworm, or nematode, that bores into the roots, causing them to develop galls or swellings; hence the name "root knot," commonly applied to this trouble. The disease is easily recognized by examining the roots. The growth of the plant is retarded, and in some cases the leaves turn yellow. This disease is readily controlled by rotation of crops, provided highly resistant crops are used and a crop of tobacco is grown only every third or fourth year. The Iron and Brabham varieties of cowpeas, velvetbeans, corn, wheat, oats, rye, sorghum, peanuts, and grasses may be used in the rotation, but most other crops, including cotton and the ordinary varieties of cowpeas, should be avoided.

MOSAIC

One of the most widespread maladies of the tobacco plant is known as mosaic, calico, or walloon. The chief symptom is a mottling of the leaf, parts of which are of a lighter green color than the rest of the leaf, and this mottling may extend also to the blossoms. In severe cases of the disease there may be various malformations and distortions of the leaves. The disease is highly infectious and may be communicated from diseased to healthy plants by laborers in transplanting, topping, or suckering. Tobacco plants are seldom killed by mosaic, but both the yield and the quality of the crop may be injured. The disease may be carried over in the soil. Care should be taken to avoid spreading it by handling healthy plants after having touched diseased green or cured ones. Rigid seedbed sanitation is the most important preventive measure. Resistant or tolerant varieties have been developed and are being grown in a limited way.

FRENCHING

Another disease, frequently confused with mosaic, is properly known as "frenching." This disease is not infectious and is due to some unfavorable condition of the soil. In severe cases the leaves of the plant are so long and narrow that they may be spoken of as stringy or ribbonlike, and they are extremely thick and brittle. In milder forms of the malady the leaves are small, narrow, stiff, and stand up in an erect manner. The upper surface of the young leaves shows numerous golden-yellow spots, and the leaves are thick. The disease may occur at any stage of development, and often only the upper part of the plant is affected. Defective drainage seems to be a contributory cause of the disease, and it appears that deficiencies in plant food may cause symptoms of the trouble. Correction of the cause of the trouble often leads to the recovery of the plants.

LEAF SPOT DISEASES

A number of different names have been applied to the leaf spot diseases of tobacco that have appeared in severe form from time to time in different tobacco-growing sections. Among these names may be mentioned "blight," "fire," "red fire," "wildfire," "red rust," "brown rust," "speck," "frog-eye," and "angular leaf spot" or "black fire." It appears that there are several distinct leaf spot diseases, most of which are caused by fungi and bacteria. Observation shows that most, if not all, of these diseases develop in severe form only under a special combination of conditions, so that in any particular locality they are not likely to prove especially destructive, except in certain years and at rather infrequent intervals. Broadly speaking, the so-called rusts have been most prevalent in northern cigar-tobacco districts, and the red rust or brown rust frequently follows as a sequel to the mosaic disease. The so-called wildfire and the angular leaf spot or black fire, which are very similar diseases, have caused considerable damage in various districts in recent years. Both are bacterial diseases. They usually appear first in the seedbed, but the means chiefly responsible for carrying the bacteria through the winter are not definitely known. The soil of the seedbed should be sterilized by steaming or by thorough surface burning, and the frames and covers may be treated with formaldehyde or steam. Early, thorough applications to the seedlings of bordeaux mixture or a fixed copper material in advance of applying the blue mold control measures described below are recommended. Care should be taken to prevent any tobacco trash from infected crops or other organic matter likely to harbor the germs of the disease from reaching the seedbed. No specific remedy for these diseases has been found, once they have attacked the plant, but dry weather usually checks their progress. The tobacco plant is subject to attack at any stage of development, but seems to be particularly susceptible at the time it reaches maturity. The diseases are more destructive in periods of wet, stormy weather, and their progress may be rapidly checked by dry clear weather. An abundant supply of nitrogen in the soil or fertilizer and low topping of the plants are predisposing factors toward injury from these leaf spots, while a liberal supply of potash in the fertilizer tends to increase the resistance of the plants to the diseases.

BLUE MOLD

The blue mold disease may be observed on plants in the field, but with the exception of tobacco grown under shade it has only caused serious losses in the seedbed, where it has been prevalent and destructive in practically all tobacco-producing areas. It first becomes apparent in the seedbed as circular patches of yellowed leaves, which on careful examination show on the under side a fungus growth of a pale white or violet color. Gas, dust, and spray treatments have been developed that give good control of the disease when properly used. The gas treatment using paradichlorobenzene and additional covers to retain the gas has the advantage that the treatment can be started after the disease appears, but there is one serious handicap in that, when low temperatures prevail, the gas may not volatilize in sufficient quantities

to give control of the disease. Effective control of blue mold has been found to be possible by the use of ferric dimethyl dithiocarbamate (Fermate) or other materials in a systematic spray or dusting schedule, with treatment beginning prior to appearance of the disease.

POTASH HUNGER

An insufficient supply of potash in the soil for normal growth and development of the tobacco crop usually produces characteristic symptoms in the leaf that are easily recognized by those familiar with the disease. First indications of this trouble are usually seen on the tips and margins of the lower leaves, but in some cases the tips of the middle leaves are first affected. Beginning at the tip a chlorosis or yellowing of the leaf surface develops that is often followed by the appearance of numerous small specks of dead tissue. The growth of the leaf is uneven, and the surface becomes rough and puckered, the slower growth of the tip and edges causing a characteristic curving downward of these parts. As the disease progresses the margins of the leaf may become torn and ragged, and large splotches of dead tissue develop over the surface. In severe cases the parts of the leaf that remain green assume an abnormally dark, muddy, bluish-green shade. This disease, which is readily controlled by using an adequate supply of potash in the fertilizer, is more commonly seen on light sandy and sandy loam soils, especially in the Coastal Plain section of the flue-cured district.

MAGNESIA HUNGER (SAND DROWN)

On some of the light sandy and sandy loam tobacco soils, especially in seasons of heavy rainfall, pronounced symptoms of disease, due to an insufficient supply of magnesia, make their appearance. This disease is commonly known as sand drown, because it is likely to be more severe on sandy spots in the field and after heavy rains. Some care is required to distinguish between the symptoms of sand drown and those of potash hunger, since both may occur on the same soil and even on the same plants. Sand drown always begins on the lower leaves and at the tips and along the margins of the leaves. The green color is bleached out, leaving the affected leaf surface almost white. Ordinarily the leaf surface remains smooth, and there is less tendency toward spotting or specking than in potash hunger. The leaf margin does not curve downward, as in potash hunger, but in some cases may turn upward. The use of a fertilizer supplying 10 to 20 pounds of magnesia per acre in available form, if applied in the drill, usually suffices for the control of magnesia hunger. Sulfate of potash-magnesia is suitable for this purpose. Dolomitic limestone (high in content of magnesia) applied in the drill at the rate of 500 pounds or broadcast at the rate of 1,000 pounds or more per acre is effective. Fertilizers of vegetable origin, such as cottonseed meal and tobacco stems, and manure also tend to prevent the disease.

INSECT ENEMIES OF TOBACCO

One of the most troublesome and expensive features of tobacco culture, particularly in the southern districts, is the control of numerous

insects which, if not combated, would oftentimes completely destroy the commercial value of the crop. Among the more important insects attacking the tobacco plant are aphids, tobacco flea beetles, the tobacco wireworms, cutworms, the hornworms, and the tobacco budworms.

Of these, the hornworms, or green worms, are usually the most destructive.

For detailed information regarding insects attacking tobacco and methods of combating them, the reader is referred to bulletins on this subject issued by the United States Department of Agriculture and the State experiment stations.

SELECTING SEED PLANTS AND SAVING THE SEED

The first step in producing a satisfactory crop of tobacco is to use good seed, true to type, and before topping is done the tobacco field should be gone over carefully in search of desirable seed plants. The ideal type of plant desired having been definitely decided upon, only those plants that conform to this type should be selected for growing seed. The advantages of selecting good seed plants will be lost if crossing with other types is allowed to take place. This is prevented readily by covering the flower head with a 12- to 16-pound manila paper bag, manufactured with waterproof glue, in the manner shown on the cover page of this bulletin. The small leaves and branches just below the flower head proper should be removed, and the mouth of the bag securely tied to the stalk just below the flowering branches. Any blossoms that have already opened must be picked off before the bag is placed in position. The bag must be adjusted from time to time to accommodate the growth of the flower head.

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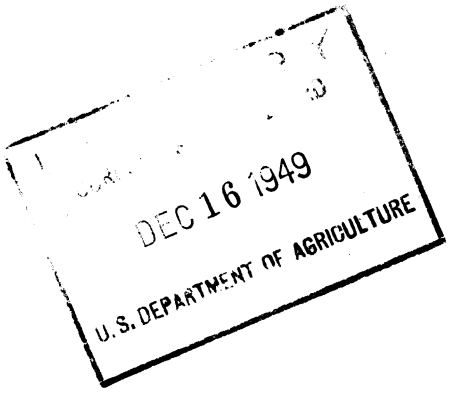
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